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# Three-dimensional ultrasound in obstetrics practice: myth or reality?

*Ultrassonografia tridimensional na prática obstétrica: mito ou realidade?*

Editorial

Since the introduction of sonography into clinical practice, two-dimensional ultrasound (2DUS) has represented the standard application in obstetrics care. Nonetheless, technological advancement has brought to healthcare givers a new opportunity that is three-dimensional ultrasound (3DUS). Are there nowadays convincing evidence that 3DUS offer advantages over 2DUS and have gained recognized as well as well established role to justify its inclusion into routine obstetrics practice? The technological advancement reached by 3DUS warrant appropriate operator training program in order to acquire expertise to manage ultrasound applications and software. When this "goal" is reached, there is no doubt concerning the fact that one of the main advantages of 3DUS over 2DUS is represented by anatomic acquisition of a volume. Once a volume data set has been acquired, it can be sectioned on-line or transferred to an external personal computer for post-processing analysis. At this stage, "navigation" within the volume is possible, and operators can then freely sectioned or rendered the volume on-demand. This is of dramatic importance in teaching and training clinical setting. Furthermore, volume can be acquired on standardized plane at remote site even by inexperienced operator in 3DUS and send for expert consultation using telemedicine. Although stored volume data sets are large, up to 10 megabyte, they can be compressed to about 15 to 20% of the original file size and submitted via Digital Imaging and Communications in Medicine (DICOM) technology for off-line consultation without noticeable loss of details or image quality[1]. Moreover, volume data sets can be shared by expert on dedicated website and be used in multicenter studies while demonstrating a high sensitivity and reliability[2,3].

3DUS with its applications allow operators a simultaneous and less time consuming (when compared with 2DUS) rendering of the anatomical landmarks in three orthogonal planes when using the multiplanar mode. In such case, the region of interest is displayed on the upper left quadrant on the ultrasound video equipment while the sagittal plane, the coronal and the axial are rendered in plane A, plane B and plane C, respectively. The planes obtained from the 3D volume are parallel and not oblique or at an angle, as is the case with conventional 2DUS. In addition, when comparing 2DUS vs. 3DUS studies of pathological cases, one of the most important advantages offered by "navigating" inside the volumes generated by 3DUS is the ability to follow the green "reference" dot that indicates the

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same anatomical point on all three orthogonal planes and thus facilitating identification of the targeted site[4]. With technological advancement of "real-time" high-resolution 3DUS machine, volume data sets of the "volume of interest" (VOI) can be acquired in only few seconds and motion artifacts due to fetal movements may be minimized. In case of active fetal movements, volume can be acquired using the 3D live mode (4D) facility rather than using the static 3D mode. This option has demonstrated its clinical value when reconstructing the fetal face[5] and/or the cardiac structures using the spatio-temporal-image correlation (STIC) technique[6-9]. Tonni et al.[5] have demonstrated that 3DUS have enhanced the diagnostic accuracy in detecting cleft lip (CL) and cleft palate (CP) in a routine second trimester scan on low-risk pregnant women. To enhance prenatal detection of CL/CP, different 3DUS techniques as the "reverse face"[10], the "flipped" face[11], the "oblique"[12] and the "angle insonation"[13] view have been developed and proposed for inclusion into clinical obstetrics practice.

A dramatic improvement in the study of fetal brain anatomy (neurosonogram) has been accomplished by 3DUS when compared with conventional 2DUS. The main disadvantage shown by 2DUS in this clinical setting is that the basic neurosonogram examination is limited to the axial plane while for a thorough investigation may require insonation of the sagittal and coronal planes[14]. However, visualization of these additional planes requires either a transvaginal or a transabdominal approach with a transfrontal view through the metopic suture as well as operator expertise and favourable fetal position. A 3DUS has been suggested as a method that is able to overcome the limitations of dependence on operator skills[15].

Novel 3DUS reconstructing technique now enables operators to trace cross-sectional planes freely to obtain "virtual" nonrigid planes to reconstruct the anatomy. This new "reslicing" technique can provide reliable manipulation of 3D volume data sets to obtain snapshots of fetal anatomy that have proven to be clinically useful in prenatal diagnosis[16-18]. 3DUS with STIC has enhanced the study of the fetal cardiac and of great artery outflow tract. With cardio-STIC, volume data sets are obtained in the 3D static mode (no cardiac motion) or using 4D — the three dimensional heart is observed contracting during one or multiple cardiac cycles. Data can then be manipulated along the x- and y-axes using reference points from the four-chamber view, five-chamber view, three-vessel view at the level of the bifurcation of the pulmonary arteries, and three-vessel view at the level of the transverse aortic arch and trachea. The image reconstruction enables the sonographer to evaluate intracardiac anatomy at different depth planes, and recreate casts of blood flow of the chambers and great vessels. Moreover, color Doppler STIC enable acquisition of volume data sets from the fetal heart that are displayed as a cineloop of a single cardiac cycle. Limitations to this application may be early or late gestation as a result of low discrimination of signals[19].

In summary, we believe that 3DUS with its applications may provide a powerful, step forward armamentarium to 2DUS. As availability of this technology and trained sonographer should become more widespread, it is our convincement that 3DUS should represent an integral part of obstetrics investigation and therefore be included in routine clinical practice. Our statement is in keeping with that of Gonçalves et al.[20] and Kurjak et al.[21], who declared that "three-dimensional ultrasound provides additional diagnostic information for the diagnosis of facial anomalies, neural tube defects, and skeletal malformations although additional research is needed to determine its clinical role in the diagnosis of congenital heart disease and central nervous system anomalies.

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